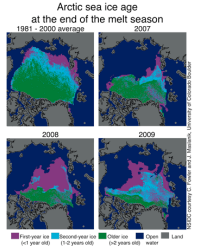
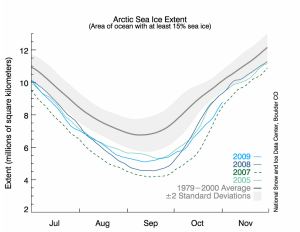
The Climate Response to 2007 Arctic Sea Ice Loss

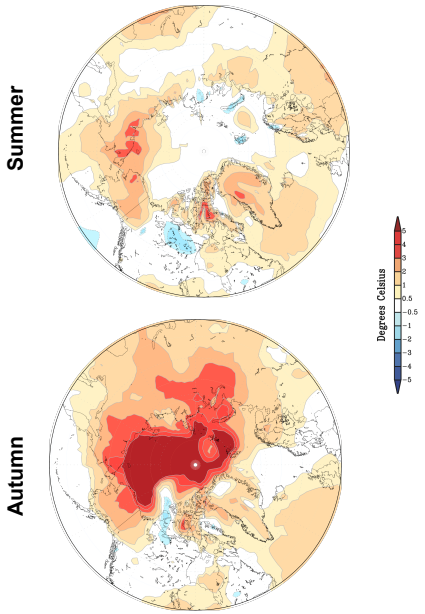
Depleted Arctic Sea Ice





Arctic sea ice in 2007 reached its lowest extent since at least 1978. By the end of the melt-season in September, sea ice suffered a -39% areal decline, with an unusual exposure of a vast expanse of the Arctic Ocean occurring poleward of the Russian and western North American coasts (top figures, from NSIDC)

Observed Arctic Warming



Most of the Arctic experienced high surface temperatures in 2007, especially over the Arctic Ocean in Autumn in areas where sea ice vanished. Considerable warmth also occurred over the Arctic tundra. The recent high latitude warming is consistent with the emergence of a surface-based Arctic amplification (Serreze et al. 2009).

Observed Data: Summer (June-July-August) and Autumn (September-October-November) surface air temperature is based on the Hadley Center's CRTUv3 and NASA analyses over land, and on the NCEP-NCAR Reanalysis over the Arctic Ocean. Reference period is 1971-2000.

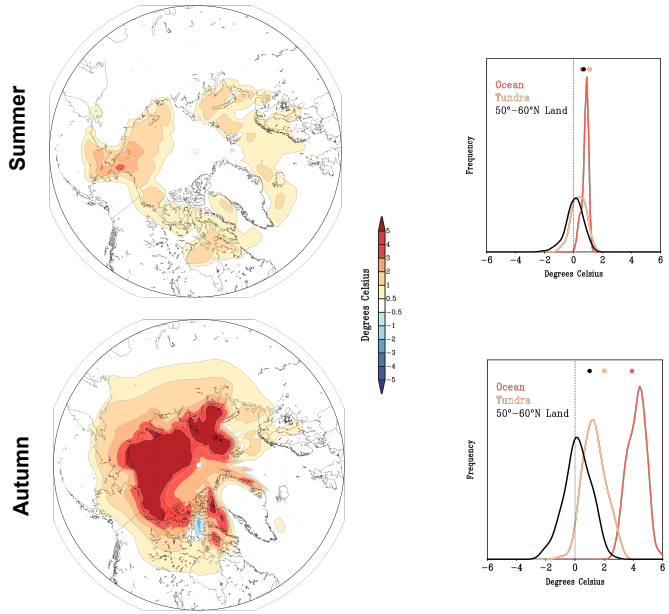
Assessing Impacts of 2007 Arctic Sea Ice

Q1: What was the impact of 2007 sea ice conditions on Arctic surface temperature?
Sea ice loss explains virtually all of the autumnal warming over the Arctic Ocean during 2007. Sea ice impacts on temperature are confined mostly poleward of 60°N.

Q2: What was the seasonality of the sea ice impacts during 2007?
The greatest sea-ice induced warming occurred in the Autumn and early Winter.

***Q3:* How did the Arctic tundra respond to 2007 sea ice relative to the Arctic Ocean?**
Autumn Arctic tundra (land poleward of 60°N) surface temperatures warmed by +1.3°C due to sea ice forcing compared to a +3.9°C warming averaged over the Arctic Ocean. Sea ice exerted little or no impact on land temperatures equatorward of 60°N.

Simulated Arctic Warming



To address the above questions, atmospheric GCMs were subjected to the 2007 monthly global SSTs and sea ice, while a parallel suite used the same SSTs but climatological sea ice. Their difference evaluates the 2007 sea ice impacts. Also shown are probability distribution functions, based on 150 runs, of surface temperature for three regions (observed values shown by dots):
a) Arctic Ocean poleward of 65°N, b) Arctic tundra poleward of 60°N, c) land between 50°-60°N

Model Data: Three models were used: NCEP's GFS, GFDL's AM2.1, and NCAR's CCM3.
A 50-member ensemble was conducted with each model, and for each of the two boundary forcings

Martin Hoerling, Judith Perlwitz, Jon Eischeid, Xiao-Wei Quan, TaiYi Xu, and Arun Kumar[1]: *NOAA Earth System Research Laboratory and [1]NOAA NCEP*